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LISTS OF SPECIES

Phytoplankton of the northern coastal and shelf waters of the Yucatan Peninsula, southeastern Gulf of Mexico, Mexico

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ABSTRACT: Based on long-term monitoring (2001-2012) and four oceanographic cruises (2010-2012) in the coastal and shelf waters of the Yucatan Peninsula, SE Gulf of Mexico, a list of 306 strictly phytoplanktonic and tychoplanktonic species from 131 genera is presented: centric diatoms (83 species), raphid diatoms (47), araphid diatoms (22), Dinoflagellata (124), Cyanoprokaryota (18), Ebriacea (2), Chlorophyceae (3), Dictyochophyceae (2), Euglenophyceae (2), Cryptophyceae (1), Prymnesiophyceae (1), and Raphidophyceae (1). Diatoms also dominated the number of genera (80) followed by dinoflagellates (39) and cyanobacteria (11). The genera most abundant in species were *Chaetoceros* Ehrenb. (23 species), *Protoperidinium* Bergh (23) and *Ceratium* Schrank (17). The relative richness in species of the genus *Oxytoxum* (11 species) is related to the tropical affiliation of the phytoplankton community. Most of the tychoplanktonic diatoms (57 species out of a total of 152 diatoms, or 37.5%) were observed principally from coastal samplings. Eighteen potentially toxic species were found.

INTRODUCTION

While there are checklists of both diatoms and dinoflagellates found in the Gulf of Mexico as a whole (Krayevsky *et al.* 2009, Steidinger *et al.* 2009) and a checklist of dinoflagellates of the southern Gulf of Mexico (Licea *et al.* 2004), information on planktonic algae of the Yucatan waters is scarce. Some data can be found in recently published literature (Licea *et al.* 2004; Troccoli Ghinaglia *et al.* 2004; Álvarez-Góngora and Herrera-Silveira 2006; Herrera-Silveira and Morales-Ojeda 2009; Álvarez-Góngora *et al.* 2012) and in a number of unpublished bachelors, masters and doctoral theses; the latter are considered gray literature and are not cited here.

To provide a preliminary list of both planktonic and tychoplanktonic microalgae found in the coastal waters of the northern Yucatan Peninsula, based on original water-bottle samples, was the main purpose of this study.

MATERIALS AND METHODS

A dry warm climate characterizes the study area. Three seasons can be distinguished: a dry season from March to early June, a rainy season from June to October, and the "nortes" (northerly winds) season with short periods of storms and strong winds coming from the north, from November to February (Herrera-Silveira 1993).

Study area and sampling

Phytoplankton was sampled using a Van Dorn bottle during the coastal monitoring surveys in 2001-2012 and on four oceanographic cruises (Table 1). For this study, all the stations located on the continental platform of the northern part of the Yucatan Peninsula and some stations beyond the 200-m isobath were considered. Coastal samples were collected at 17 sites along the coast line between Chuburná and Dzilam de Bravo (Figure 1). Sea water was taken at 0.5-1.0 m depth, 10-20 m from the beach; the water temperature ranged from 20.3 to 35.9°C and salinity ranged from 27.0 to 39.4 (down to 15.0 in the marina of Dzilam de Bravo). The samples were analyzed quantitatively using the Utermöhl method (Hasle 1978). Carl Zeiss Axiovert 100 and Olympus CK2 inverted microscopes were used.

Identifications were principally made at the species level when possible; otherwise, identification was at the generic level. Tychoplanktonic species were also included. Information about the main habitat for some species of cyanobacteria, chlorophytes and pennate diatoms such as *Haslea* spp. remain unknown. AlgaeBase was consulted to verify currently accepted taxonomic names (Guiry and Guiry 2012). Abbreviations of authors of scientific names are used according to Brummit and Powell (1992) unless they were not listed in the book. The major eukaryotic groups are ordered in the list according to Adl *et al.* (2012). For diatoms, the division into three classes by Round *et al.* (1990) was followed, taking into account the most recently published catalogue of diatom genera (Fourtanier and Kociolek 1999).

RESULTS AND DISCUSSION

In total, 306 obligatorily phytoplanktonic and tychoplanktonic species from 131 genera were found (Table 2): centric diatoms (83 species), pennate raphid diatoms (47), pennate araphid diatoms (22), Dinoflagellata (124), Cyanoprokaryota (18), Ebriacea (2), Chlorophyceae (3),

Dictyochophyceae (2), Euglenophyceae (2), Cryptophyceae (1), Prymnesiophyceae (1), and Raphidophyceae (1) (Figure 2). At least 24 species remained unidentified to the species level. The genera most abundant in species number were *Chaetoceros* Ehrenb. (23 species), *Protoperidinium* Bergh (23) and *Ceratium* Schrank (17). The prevalence of the former two genera is characteristic for both temperate and tropical regions. Furthermore, the following genera were well represented: *Prorocentrum* Ehrenb. (12 species), *Oxytoxum* F. Stein (11), *Amphora* Ehrenb. ex Kütz. (9), and *Nitzschia* Hassall (8). The genus *Amphora* is represented exclusively by tychoplanktonic species. The relative richness in species of the genus *Oxytoxum* is related to the tropical affiliation of the phytoplankton community. Diatoms also dominated in the number of genera (80) followed by dinoflagellates (39), and cyanobacteria (11), with the rest of the major taxonomic groups contributing only one, two or three genera each.

Based on recently published literature on diatoms and dinoflagellates (Okolodkov *et al.* 2007; 2011a; Okolodkov, 2008; 2010; Krayevsky *et al.* 2009; Steidinger *et al.* 2009; Aké *et al.* 2012) and Wood (1968), new records for the Gulf of Mexico were revealed (Table 2). Based on the list of diatom species by Krayevsky *et al.* (2009), five diatom species are new records for the Gulf of Mexico, although we prefer to consider them new records for the southern (Mexican) Gulf of Mexico (Table 3) because we are unaware of the most recent advances in the diatom floristics in the northern/U.S. territorial waters of the Gulf of Mexico. Out of five new records of diatom species, four are tychoplanktonic. The dinoflagellates *Oxytoxym constrictum* and *O. tesselatum* are absent in the list of Steidinger *et al.* (2009); however, they were reported from the Straits of Florida and the Caribbean Sea (Wood 1968). Thus they can be considered new records for the southern Gulf of Mexico. The highest occurrences were shown by *Neostreptotheca subindica* and *Oxytoxum tesselatum*; four species were found exclusively during coastal surveys (Table 3). *Scrippsiella spinifera*, originally described from the Mediterranean, was also observed in the northern Yucatan waters as a relatively common species accompanying a bloom caused by *S. trochoidea*

Table 1. Hydrological (at 10 m depth) and bathymetrical data on oceanographic cruises around the northern Yucatan Peninsula.

CRUISE	DATES	SUBSURFACE WATER TEMPERATURE (°C)	SALINITY	SITE DEPTHS (M)
Xcambo-IV	9 September – 3 October 2010	27.70-30.50	19.00-36.78	4.0-200.0
GOMEX-2010	11-21 September 2010	21.93-30.12	32.65-36.73	15.0-200.0
GOMEX-2011	25 September – 2 October 2011	22.86-31.35	16.42-36.76	13.6-204.0
CO-12	9 July – 5 August 2012	24.70-29.10	36.40-37.20	16.0-256.0

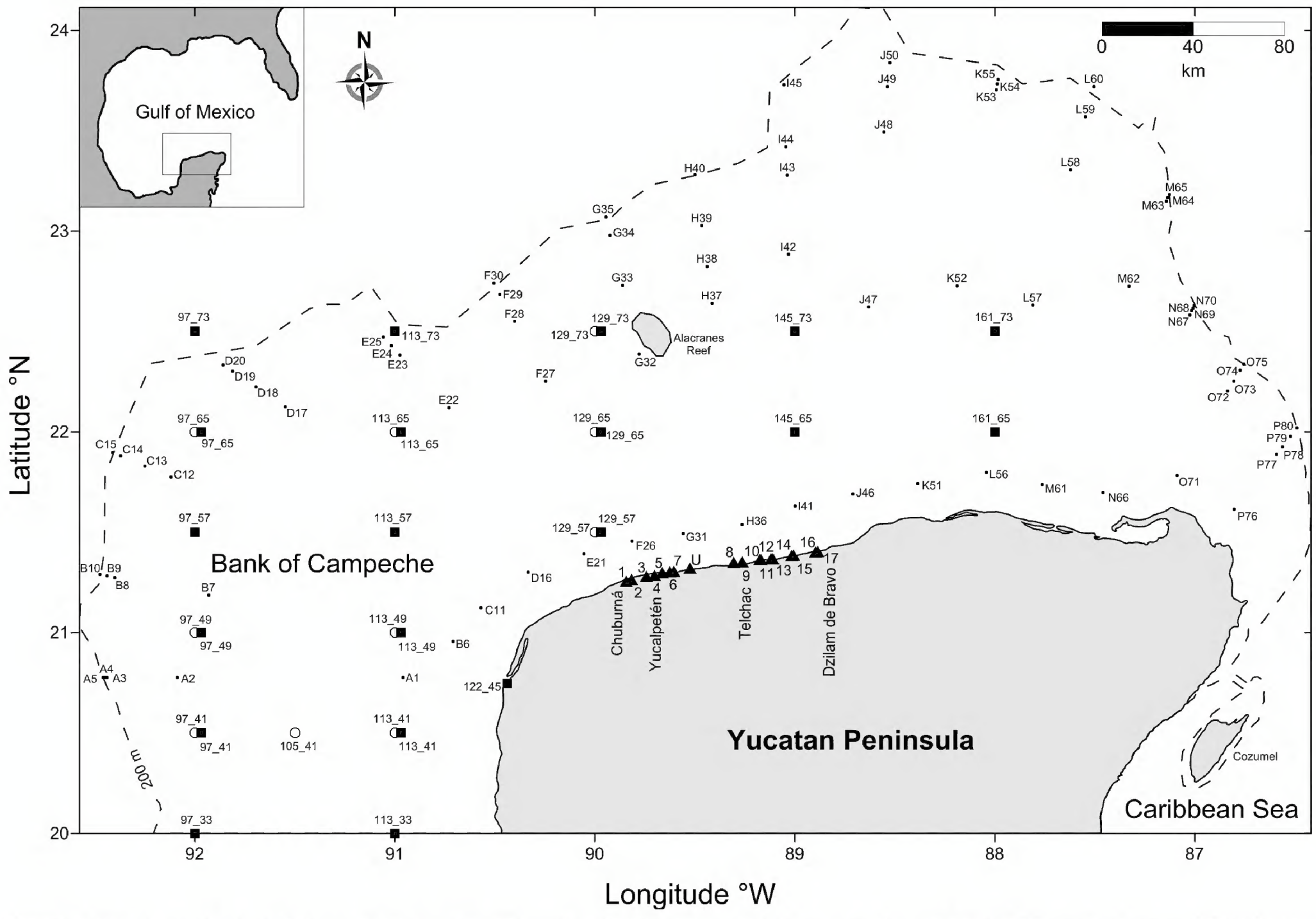

Figure 1. Sampling sites around the northern Yucatan Peninsula: filled triangles mean (oceanographic) stations of the coastal surveys (2001-2012), empty circles – Xcambo IV, filled small circles – GOMEX-2010 and GOMEX-2011; filled squares – CO-12.

in the marina of Dzilam de Bravo on 19 May 2009. It has been previously found in Yucatan waters, in the states of Campeche and Quintana Roo (Troccoli Ghinaglia *et al.* 2004), although it is not included in a checklist of dinoflagellates for the Gulf of Mexico published more recently (Steidinger *et al.* 2009). Therefore, we report it here for the first time for the state of Yucatan.

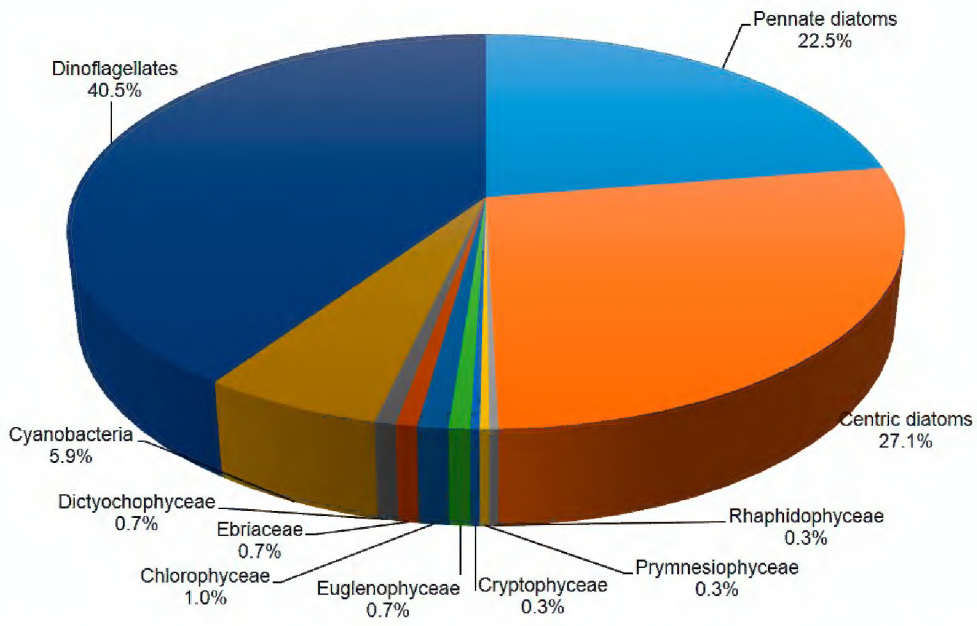

Figure 2. Distribution of major taxonomic groups of phytoplankton in the coastal and shelf waters of the northern part of the Yucatan Peninsula, southeastern Gulf of Mexico.

Most of the tychoplanktonic diatoms (57 species out of a total of 152 diatoms, or 37.5%) were also observed principally from coastal samplings. The portion of freshwater species (mainly cyanobacteria and chlorophyceans) was pronounced (21 species, or 6.8%); however, they were never observed as abundant or even frequent in terms of the number of cells. The small number of benthic dinoflagellates found in plankton samples, compared to diatoms, can be explained by the rather low species richness of benthic dinoflagellates in general: at the northern Yucatan coast, 20 epiphytic dinoflagellate species from 12 genera were encountered (Okolodkov *et al.* 2011b). It is widely known that benthic diatoms outnumber benthic dinoflagellates in the number of species both locally and globally.

Due to the optical limitations of inverted microscopes, we failed to identify *Pseudo-nitzschia* species. Nevertheless, our findings in coastal waters of the State of Veracruz (Parsons *et al.* 2012) imply the occurrence of at least five toxic species that can cause amnesic shellfish poisoning. In contrast, among dinoflagellates the potentially toxic species were easier to identify. Most of these species were rare in the samples. Only *Prorocentrum minimum* was observed in high abundances in marinas (particularly in Chuburná, Yucalpetén, Telchac y Dzilam de Bravo; stations 1, 4, 9 and 17 of the coastal surveys; (Figure 1), up to 7.1×10^7 cells l^{-1} (Merino-Virgilio *et al.* 2011a). Another species, *Pyrodinium bahamense* var. *bahamense,* considered potentially toxic only due to a single report on the toxicity of var. *bahamense* in the coastal waters of East Florida (Landsberg *et al.* 2006), reached the population density of 1.8×10^5 cells l^{-1} (Merino-Virgilio *et al.* 2011b). In total, 18 potentially toxic species (16 dinoflagellates and two cyanobacteria) were found.

The presented list can be considered preliminary. Among planktonic diatoms, we expect to identify more *Thalassiosira* Cleve and *Coscinodiscus* Ehrenb. species, as well as even more tychoplanktonic diatoms, above all, from the genera *Licmophora* C. Agardh, *Amphora* Ehrenb. ex Kütz., *Nitzschia* Hassall, *Navicula* Bory, *Pleurosigma* W. Sm., *Cocconeis* Ehrenb. and some others that escaped our attention during routine counts and that need a thorough examination of frustule morphology. As regarding flagellates, the species diversity, first of all, of naked dinoflagellates from the order Gymnodiniales and nanophytoflagellates was underestimated due to methodological problems.

Table 2. List of phytoplankton species of the northern coastal and shelf waters of the Yucatan Peninsula (2002-2012) from water-bottle samples (b – benthic or tychoplanktonic marine (epiphytic, epipelic or epilithic), f – freshwater (sometimes brackish-water) planktonic, t – potentially toxic).

TAXA	COASTAL SURVEYS	XCAMBO-IV	GOMEX 2010	GOMEX 2011	CO-12
CYANOPROKARYOTA	+				
Anabaena sp.[f]					+
Aphanothece sp.[f]	+				
Arthrospira sp.[f]	+				
Chroococcus sp.	+				
Gloeocapsa gelatinosa Kütz.[f]	+				
Merismopedia convoluta Bréb. ex Kütz.[f]	+				
Merismopedia glauca (Ehrenb.) Kütz.[f]	+				
Merismopedia punctata Meyen[f]	+				
Merismopedia elegans A. Braun ex Kütz.[f]	+				
Oscillatoria limosa C. Agardh ex Gomont[f]	+				
Oscillatoria tenuis C. Agardh ex Gomont[f]	+				
Spirocoleus fragilis (Menegh.) P. C. Silva[f]	+				
Spirulina sp.	+				
Trichodesmium erythraeum Ehrenb.[t]				+	
Trichodesmium thiebautii Gomont ex Gomont[t]	+	+		+	
DICTYOCHOPHYCEAE					
Dictyocha fibula Ehrenb.		+	+		+
Mesocena polymorpha Lemmerm.					+
RAPHIDOPHYCEAE					
Chattonella cf. *subsalsa* Biecheler			+	+	

TABLE 2. ***CONTINUED.***

TAXA	COASTAL SURVEYS	XCAMBO-IV	GOMEX 2010	GOMEX 2011	CO-12
BACILLARIOPHYTA: COSCINODISCOPHYCEAE					
Actinoptychus senarius (Ehrenb.) Ehrenb.[b]	+				
Bacteriastrum delicatulum Cleve	+				
Bacteriastrum elongatum Cleve	+				
Bacteriastrum furcatum Shadbolt			+	+	
Bacteriastrum hyalinum Lauder	+		+	+	
Bellerochea malleus (Brightw.) Van Heurck	+				
Biddulphia alternans (Bailey) Van Heurck[b]	+				
Biddulphia biddulphiana (W. Sm.) Boyer[b]	+			+	
Biddulphia rhombus (Ehrenb.) W. Sm.[b]	+				
Cerataulina pelagica (Cleve) Hendey	+		+	+	+
Chaetoceros affinis Lauder	+		+	+	+
Chaetoceros anastomosans Grunow	+				
Chaetoceros brevis F. Schütt	+				
Chaetoceros coarctatus Lauder			+	+	
Chaetoceros compressus Lauder	+		+		+
Chaetoceros costatum Pavill.	+	+		+	
Chaetoceros curvisetus Cleve				+	
Chaetoceros debilis Cleve	+				
Chaetoceros decipiens Cleve	+	+	+	+	
Chaetoceros dichaeta Ehrenb.	+		+	+	
Chaetoceros didymus Ehrenb.	+		+	+	+
Chaetoceros difficilis Cleve	+				
Chaetoceros diversus Cleve		+	+	+	+
Chaetoceros lacinosus F. Schütt	+		+		
Chaetoceros lorenzianus Grunow	+			+	
Chaetoceros messanensis Castrac.				+	+
Chaetoceros pelagicum Cleve	+				
Chaetoceros pendulus G. Karst.		+	+	+	
Chaetoceros peruvianus Brightw.	+		+	+	
Chaetoceros pseudocurvisetus Mangin	+			+	
Chaetoceros socialis Lauder				+	
Chaetoceros teres Cleve	+		+	+	
Chaetoceros tortissimus Gran	+				
Climacodium biconcavum Cleve				+	
Climacodium frauenfeldianum Grunow			+	+	
Corethron hystrix Hensen	+			+	
Coscinodiscus centralis Ehrenb.	+				
Coscinodiscus perforatus Ehrenb.	+	+		+	
Coscinodiscus wailesii Gran et Angst	+				
Cyclotella antiqua W. Sm.[f]	+				
Cyclotella marina (Tanimura, Nagumo et Kato) Aké-Castillo, Okolodkov et Ector in Aké-Castillo *et al.*	+				
Cymatosira lorenziana Grunow[b]	+		+	+	+
Dactyliosolen fragilissimus (Bergon) Hasle	+			+	
Ditylum brightwellii (T. West) Grunow				+	
Eucampia cornuta (Cleve) Grunow		+	+	+	
Eucampia zodiacus Ehrenb.	+		+	+	+
Guinardia cylindrus Cleve			+		
Guinardia delicatula (Cleve) Hasle	+	+	+	+	+
Guinardia flaccida (Castrac.) H. Perag.	+		+	+	+
Guinardia striata (Stolterf.) Hasle	+	+	+	+	+
Helicotheca tamesis (Shrubsole) Ricard	+	+	+	+	
Hemiaulus hauckii Grunow in Van Heurck	+	+	+	+	
Hemiaulus membranaceus Cleve		+			
Hemiaulus sinensis Grev.	+	+	+	+	+
Isthmia enervis Ehrenb.[b]	+			+	
Lauderia annulata Cleve	+				
Leptocilyndrus danicus Cleve	+	+	+	+	+
Lithodesmium undulatum Ehrenb.	+				

TABLE 2. ***CONTINUED.***

TAXA	COASTAL SURVEYS	XCAMBO-IV	GOMEX 2010	GOMEX 2011	CO-12
Melosira nummuloides C. Agardh[b]	+				
Neocalyptrella robusta (G. Norman ex Ralfs in A. Pritch.) Hernández-Becerril et Meave del Castillo		+	+	+	+
Neostreptotheca subindica Stosch	+		+	+	
Odontella aurita (Lyngb.) C. Agardh[b]	+		+	+	
Odontella mobiliensis (Bailey) Grunow[b]	+				
Odontella tuomeyi (Bailey) F. C. S. Roper[b]	+				
Paralia fenestrata Sawai et Nagumo[b]	+		+	+	+
Plagiogrammopsis vanheurckii (Grunow) Hasle, Stosch et Syvertsen				+	
Planktoniella sol (G. C. Wall.) F. Schütt				+	+
Proboscia alata (Brightw.) Sundström	+	+		+	+
Proboscia indica (H. Perag.) Hernández-Becerril	+		+		
Pseudosolenia calcar-avis (Schultze) B. G. Sundström	+	+	+	+	
Rhizosolenia acuminata (H. Perag.) H. Perag in H. Perag. et Perag.	+			+	
Rhizosolenia bergonii H. Perag.	+		+	+	
Rhizosolenia hebetata Bailey var. *semispina* (Hensen) Gran	+	+	+	+	+
Rhizosolenia imbricata Brightw.	+		+	+	+
Rhizosolenia setigera Brightw.	+	+	+	+	+
Rhizosolenia styliformis Brightw.	+		+	+	+
Skeletonema costatum (Grev.) Cleve				+	
Stephanopyxis palmeriana (Grev.) Grunow	+			+	
Thalassiosira eccentrica (Ehrenb.) Cleve				+	
Thalassiosira sp.	+				
Triceratium favus Ehrenb.[b]	+				
Triceratium pentacrinus (Ehrenb.) G. C. Wall.	+			+	
Triceratium reticulatum Grev.[b]	+			+	
BACILLARIOPHYTA: FRAGILARIOPHYCEAE					
Asterionella formosa Hassal	+				
Asterionella gracillima (Hantzsch) Heib.	+				
Asterionellopsis glacialis (Castrac.) Round	+				+
Climacosphenia sp.[b]	+			+	
Grammatophora marina (Lyngb.) Kütz.[b]	+		+	+	
Grammatophora oceanica Ehrenb.[b]				+	
Hyalosira interrupta (Ehrenb.) Navarro[b]	+		+	+	
Licmophora spp.[b]	+		+	+	
Lioloma delicatulum (Cupp) Hasle	+				
Podocystis perrinensis Ricard[b]	+				
Rhabdonema adriaticum Kütz.[b]	+		+	+	+
Striatella delicatula (Kütz.) Grunow ex Van Heurck[b]	+			+	
Striatella unipunctata (Lyngb.) C. Agardh[b]	+		+	+	
Synedra crystallina (C. Agardh) Kütz.[f]	+				
Synedra formosa Hantzsch[f]	+				
Synedra fulgens (Grev.) W. Sm.[f]	+				
Synedra ulna (Nitzsch) Ehrenb. var. *ulna*[f]	+				
Tabellaria sp.[f]	+				
Thalassionema frauenfeldii (Grunow) Tempère et H. Perag.	+	+	+	+	+
Thalassionema nitzschioides (Grunow) Mereschk.	+	+	+	+	+
Thalassiothrix sp.	+				
Toxarium undulatum Bailey[b]	+				
BACILLARIOPHYTA: BACILLARIOPHYCEAE					
Amphora angusta W. Greg.[b]	+				
Amphora arenaria Donkin[b]	+				
Amphora crassa W. Greg.[b]	+				
Amphora decussata Grunow[b]			+	+	
Amphora inflata Grunow[b]	+				
Amphora laevis W. Greg.[b]	+		+	+	
Amphora lineolata Ehrenb.[b]	+				
Amphora ostrearia Bréb.[b]	+		+	+	
Amphora ovalis (Kütz.) Kütz.[b]	+				
Bacillaria paxillifera (O. F. Müll.) T. Marsson[b]	+			+	

TABLE 2. ***CONTINUED.***

TAXA	COASTAL SURVEYS	XCAMBO-IV	GOMEX 2010	GOMEX 2011	CO-12
Caloneis liber (W. Sm.) Cleve[b]	+				
Campylodiscus sp.[b]	+			+	
Climaconeis sp.[b]	+		+	+	+
Cocconeis scutellum Ehrenb.[b]	+			+	
Cylindrotheca closterium (Ehrenb.) Reimann et J. C. Lewin[b]	+	+	+	+	+
Dictyoneis sp.[b]	+				
Diploneis crabro (Ehrenb.) Ehrenb.[b]	+			+	
Entomoneis alata (Ehrenb.) Ehrenb.[b]	+			+	+
Gyrosigma acuminatum (Kütz.) Rabenh. var. *acuminatum*[b]	+			+	
Gyrosigma acuminatum var. *brebissonii* (Grunow) Cleve[b]	+				
Gyrosigma balticum (Ehrenb.) Rabenh.[b]	+				
Haslea frauenfeldii (Grunow) Simonsen	+			+	+
Haslea wawrikae (Hust.) Simonsen		+	+	+	
Lyrella lyra (Ehrenb.) Karajeva[b]	+				
Mastogloia sp.[b]	+				
Meuniera membranacea (Cleve) P. C. Silva		+			
Navicula cancellata Donkin[b]	+				+
Navicula directa (W. Sm.) Ralfs in A. Pritch.[b]	+			+	
Navicula distans (W. Sm.) Ralfs in A. Pritch.[b]			+	+	+
Nitzschia angularis W. Sm.[b]	+				
Nitzschia dissipata (Kütz.) Grunow	+				
Nitzschia lanceolata W. Sm.	+	+	+		
Nitzschia longissima (Bréb.) Ralfs in A. Pritch.	+	+	+	+	+
Nitzschia reversa W. Sm.	+	+		+	+
Nitzschia sicula (Castrac.) Hust.	+				
Nitzschia sigma (Kütz.) W. Sm.	+		+	+	+
Nitzschia sigmoidea (Nitzsch) W. Sm.	+				
Plagiotropis lepidoptera (W. Greg.) Kuntze[b]	+		+	+	
Pleurosigma angulatum W. Sm.[b]	+		+	+	+
Pleurosigma elongatum W. Sm.[b]	+				
Pleurosigma formosum W. Sm.[b]	+			+	+
Pleurosigma normanii Ralfs[b]	+			+	
Pleurosigma salinarum (Grunow) Grunow[b]	+				
Pseudo-nitzschia cf. *delicatissima* (Cleve) Heiden	+	+	+	+	+
Pseudo-nitzschia cf. *pungens* (Grunow ex Cleve) G. R. Hasle	+	+			
Pseudo-nitzschia cf. *seriata* (Cleve) H. Perag.	+				
Surirella fastuosa Ehrenb.[b]				+	
Trachyneis aspera (Ehrenb.) Cleve[b]				+	
DINOFLAGELLATA					
Akashiwo sanguinea (Hirasaka) G. Hansen et Ø. Moestrup[t]	+	+	+	+	
Alexandrium sp.				+	
Amphidinium carterae Hulburt[b,t]	+			+	
Amphisolenia bidentata Schröd.				+	
Amphisolenia bifurcata G. Murray et Whitting				+	
Amphisolenia globifera F. Stein				+	+
Amphisolenia schauinslandii Lemmerm.				+	
Balechina coerulea (Dogiel) F. J. R. Taylor			+		
Centrodinium sp.	+				
Ceratium belone Cleve	+		+		
Ceratium contortum (Gourret) Cleve				+	
Ceratium dens Ostenf. et Schmidt				+	
Ceratium extensum (Gourret) Cleve			+	+	+
Ceratium furca (Ehrenb.) Clap. et Lachm. var. *furca*	+	+	+	+	+
Ceratium furca var. *hircus* (Schröd.) Margalef ex Sournia	+			+	+
Ceratium fusus (Ehrenb.) Dujard.	+	+	+	+	+
Ceratium horridum (Cleve) Gran					+
Ceratium karstenii Pavill.		+		+	
Ceratium kofoidii Jörg.			+	+	
Ceratium lineatum (Ehrenb.) Cleve	+	+	+	+	+
Ceratium massiliense (Gourret) Jörg.				+	

TABLE 2. ***CONTINUED.***

TAXA	COASTAL SURVEYS	XCAMBO-IV	GOMEX 2010	GOMEX 2011	CO-12
Ceratium pentagonum Gourret			+	+	
Ceratium ranipes Cleve			+		
Ceratium teres Kof.		+	+	+	+
Ceratium trichoceros (Ehrenb.) Kof.	+	+	+	+	+
Ceratium tripos (O. F. Müll.) Nitzsch		+	+	+	+
Ceratium vultur Cleve				+	
Ceratocorys horrida F. Stein			+		
Cochlodinium sp.					+
Dinophysis caudata Saville-Kent[t]	+	+	+	+	+
Dinophysis exigua Kof. et Skogsb.				+	
Dinophysis hastata F. Stein			+		
Dinophysis ovum F. Schütt				+	
Dinophysis pusilla Jörg.			+		
Diplopsalopsis bomba (F. Stein ex Jörg.) J. D. Dodge et Toriumi					+
Gambierdiscus sp.[b]	+				
Gonyaulax digitalis (Pouchet) Kof.	+	+		+	
Gonyaulax minuta Kof. et J. R. Mich.	+				
Gonyaulax polygramma F. Stein	+		+	+	
Gonyaulax spinifera (Clap. et Lachm.) Diesing[t]	+		+	+	
Gonyaulax verior Sournia	+				
Gymnodinium flavum Kof. et Swezy				+	
Gymnodinium gelbum Kof.				+	
Gymnodinium gibbera J. Schiller	+				
Gymnodinium mitratum J. Schiller				+	
Gymnodinium rotundatum Klebs	+				
Gymnodinium simplex (Lohmann) Kof. et Swezy	+				
Gymnodinium variabile Herdman	+			+	
Gyrodinium cf. *biconicum* Kof. et Swezy	+			+	
Gyrodinium cf. *fusiforme* Kof. et Swezy	+	+	+	+	+
Gyrodinium nasutum (Wulff) J. Schiller			+	+	
Gyrodinium spirale (Bergh) Kof. et Swezy		+	+	+	
Heterocapsa sp.	+	+	+	+	
Karenia brevis (C. C. Davis) G. Hansen et Ø. Moestrup[t]	+			+	+
Karenia papilionacea A. J. Haywood et K. A. Steidinger[t]	+			+	
Katodinium glaucum (Lebour) A. R. Loebl.				+	
Lingulodinium polyedrum (F. Stein) J. D. Dodge				+	
Noctiluca scintillans (Macartney) Kof. et Swezy		+		+	
Ornithocercus steinii F. Schütt				+	
Ostreopsis sp.[b]	+				
Oxyphysis oxytoxoides Kof.	+				
Oxytoxym constrictum (F. Stein) Buetschli					+
Oxytoxym curvatum (Kof.) Kof. et J. R. Michener			+		
Oxytoxym elegans Pavill.				+	+
Oxytoxum globosum J. Schiller				+	
Oxytoxum longiceps J. Schiller		+	+	+	
Oxytoxum milneri J. Murray et Whitting			+	+	
Oxytoxum scolopax F. Stein			+	+	+
Oxytoxum subulatum Kof.				+	
Oxytoxum tesselatum (F. Stein) F. Schütt				+	+
Oxytoxum variabile J. Schiller			+		
Oxytoxum viride J. Schiller				+	
Peridinium quinquecorne T. H. Abé			+	+	+
Phalacroma mitra F. Schütt[t]			+		
Phalacroma ovum F. Schütt				+	
Phalacroma porodictyum F. Stein	+				
Phalacroma rapa F. Stein[t]			+		
Phalacroma rotundatum (Clap. et J. Lachm.) Kof. et J. R. Michener[t]		+	+		+
Podolampas bipes F. Stein			+	+	
Podolampas palmipes F. Stein				+	+
Podolampas spinifera Okamura			+	+	+

TABLE 2. ***CONTINUED.***

TAXA	COASTAL SURVEYS	XCAMBO-IV	GOMEX 2010	GOMEX 2011	CO-12
Polykrikos kofoidii Chatton			+	+	
Pronoctiluca pelagica Fabre-Domergue				+	+
Prorocentrum compressum (Bailey) T. H. Abé ex J. D. Dodge		+			
Prorocentrum cf. *concavum* Fukuyo[t]	+		+		
Prorocentrum dentatum F. Stein	+		+		
Prorocentrum gracile F. Schütt	+	+		+	+
Prorocentrum lima (Ehrenb.) F. Stein[t]	+		+		
Prorocentrum mexicanum B. F. Osorio	+		+		
Prorocentrum micans Ehrenb.			+	+	
Prorocentrum minimum (Pavill.) J. Schiller[t]	+	+	+	+	
Prorocentrum rhathymum A. R. Loebl., Sherley et R. J. Schmidt[b,t]				+	+
Prorocentrum rostratum F. Stein		+	+		
Prorocentrum scutellum Schröd.	+				+
Protoceratium reticulatum (Clap. et Lachm.) Buetschli[t]	+				
Protoperidinium abei (Paulsen) Balech				+	
Protoperidinium brevipes (P. A. Dang.) Balech	+				
Protoperidinium brochii (Kof. et Swezy) Balech	+		+	+	
Protoperidinium cerasus (Paulsen) Balech	+		+		
Protoperidinium claudicans (Paulsen) Balech			+	+	
Protoperidinium concinnum M. A. Faust	+			+	
Protoperidinium conicum (Gran) Balech	+				
Protoperidinium crassipes (Kof.) Balech			+		
Protoperidinium depressum (Bailey) Balech			+	+	
Protoperidinium divergens (Ehrenb.) Balech	+		+	+	
Protoperidinium cf. *globulum* (F. Stein) Balech	+	+	+	+	
Protoperidinium granii (Ostenf.) Balech	+	+	+	+	
Protoperidinium hirobis (T. H. Abé) Balech				+	
Protoperidinium longipes Balech	+				
Protoperidinium ovum (J. Schiller) Balech			+	+	
Protoperidinium pallidum (Ostenf.) Balech	+				
Protoperidinium pellucidum Bergh	+			+	
Protoperidinium pentagonum (Gran) Balech	+				+
Protoperidinium pyriforme (Paulsen) Balech subsp. *breve* (Paulsen) Balech	+			+	
Protoperidinium pyriforme subsp. *pyriforme*	+		+	+	+
Protoperidinium quarnerense (Schröd.) Balech			+	+	
Protoperidinium sphaericum (J. Murray et Whitting) Balech		+			
Protoperidinium steinii (Jörg.) Balech			+	+	
Protoperidinium subinerme (Paulsen) A. R. Loebl.				+	
Pyrocystis lunula (F. Schütt) F. Schütt			+	+	
Pyrodinium bahamense Plate var. *bahamense*[t]	+		+	+	
Pyrophacus horologium F. Stein	+		+	+	
Scrippsiella spinifera G. Honsell et M. Cabrini	+		+		
Scrippsiella trochoidea (F. Stein) A. R. Loebl.	+	+	+	+	+
Torodinium robustum Kof. et Swezy	+	+	+		+
Dinoflagellate cysts[b]			+	+	
EBRIACEA					
Ebria tripartita (Schum.) Lemmerm.				+	
Hermesinum sp.				+	
CHLOROPHYCEAE					
Cosmarium sp.[f]	+				
Crucigenia sp.[f]				+	
Scenedesmus sp.[f]				+	
EUGLENOPHYCEAE					
Eutreptia sp.	+				+
Eutreptiella marina da Cunha	+			+	
CRYPTOPHYCEAE					
Rhodomonas pusilla (H. Bachm.) Javorn.[f]	+				
PRYMNESIOPHYCEAE					
Phaeocystis globosa Scherffel				+	

Table 3. New records of microalgae for the southern Gulf of Mexico (CS – coastal surveys).

TAXA	CRUISE OR SURVEY	STATIONS
Diatoms:		
Neostreptotheca subindica	GOMEX-10	A4, B6, N67, N68, N69, P77
	GOMEX-11	A4, B6, N67, N69, P77
Odontella tuomeyi	CS	
Pleurosigma formosum	GOMEX-11	N66
	CO-12	113_49
Podocystis perrinensis	CS	
Triceratium reticulatum	CS	
Dinoflagellates:		
Oxytoxym constrictum	CO-12	97_57, 129_73
Oxytoxum tesselatum	GOMEX-10	A2, B9, B10, C11, C14, J46, J47, L59, M62, M63, P76

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